

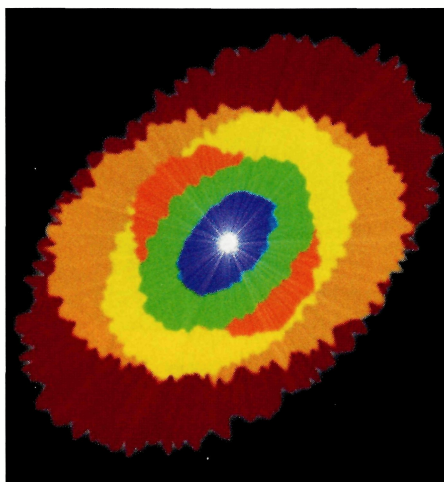
Giant flare illuminates the Earth

On 27 December 2004, one day after the devastating tsunami in the Indian Ocean, the Earth was illuminated by the biggest splash of light ever recorded from outside the solar system. For 0.2 s, the flare released as much energy as has been radiated by the Sun in 250 000 years. Five papers recently published in *Nature* describe this event.

The source of this giant flare was identified as the soft gamma repeater SGR 1806-20 located at some 50 000 light-years on the opposite side of the galaxy. Soft gamma repeaters flare up randomly and release gamma rays with a slightly softer spectrum than usual gamma-ray bursts. Only four such objects are known and a giant flare has now been detected for three of them.

The 2004 event is, however, more than an order of magnitude brighter than those recorded previously, on 5 March 1979 (SGR 0525-66) and 27 August 1998 (SGR 1900+14). Soft gamma repeaters are thought to be “magnetars” – isolated neutron stars with an extreme magnetic field that reaches 100 billion T at the surface of the star.

The most likely interpretation of this dramatic outburst is a magnetic reconnection, similar to – but much more powerful than – solar flares. Its unusual strength may be related to a quake in the crust at the surface of the neutron star. According to Kevin Hurley and collaborators, the opening of the magnetic field lines outward launched a hot fireball, a thermal pair plasma emitting the



Graphic illustrating the expanding fireball from the giant flare of SGR 1806-20. Colours indicate the observed size and shape of the fireball at different times covering roughly three weeks of observations by the Very Large Array. (Courtesy G B Taylor NRAO/AUI/NSF.)

quasi-blackbody spectrum observed during the initial gamma-ray spike with a kT value of around 200 keV (Hurley *et al.*).

This prompt emission, first reported by ESA's INTEGRAL satellite, was followed by an exponential decay lasting about 400 s. On top of the general trend, very clear oscillations have been recorded with a period of 7.56 s, the previously known spin period of the magnetar SGR 1806-20.

On 3 January 2005, the Very Large Array (VLA) in New Mexico detected a radio source at the position of the giant flare (B M Gaensler *et al.*). Further observations over the following weeks showed that the radio-emitting fireball was expanding at roughly one-third the speed of light. The source is not spherical as suggested by polarization measures. Indeed, it seems to be elongated, with its shape changing from one observation to the other.

The extraordinary luminosity of the flare of December 2004 suggests that similar events could have been seen in nearby galaxies. Such an event would look like one of the many short gamma-ray bursts (GRBs) detected by the Burst And Transient Source Experiment (BATSE) in the 1990s. Hurley and collaborators therefore speculate that about 40% of the short GRBs detected by BATSE could be due to such giant flares from magnetars. However, the suggestion by P Cameron and colleagues that SGR 1806-20 is at only about half the distance assumed for this estimate makes it less likely that such events could explain a significant fraction of the still mysterious GRBs (Cameron *et al.*).

Further reading

P B Cameron *et al.* 2005 *Nature* **434** 1112.
B M Gaensler *et al.* 2005 *Nature* **434** 1104.
K Hurley *et al.* 2005 *Nature* **434** 1098.
D M Palmer *et al.* 2005 *Nature* **434** 1107.
T Terasawa *et al.* 2005 *Nature* **434** 1110.

Picture of the month

This very sharp image was taken by the Hubble Space Telescope in celebration of its 15th anniversary. Ten years after Hubble captured the fascinating “Pillars of Creation” in the heart of the Eagle Nebula (Messier 16), the telescope once again points its eye at this beautiful nebula to reveal another dust sculpture. The delicate dust column measures approximately 10 light-years and is eroded by the intense ultraviolet light from massive young stars outside the image. (Courtesy NASA, ESA and The Hubble Heritage Team [STScI/AURA].)

